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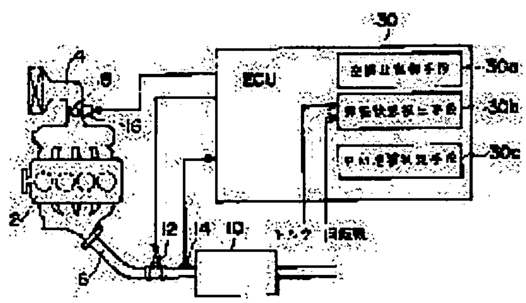
(54) EXHAUST EMISSION CONTROL DEVICE FOR INTERNAL COMBUSTION ENGINE

(57)Abstract:

PROBLEM TO BE SOLVED: To enable ignition of particulates for combustion, caught even in the low-temperature combustion conditions.

SOLUTION: A particulate filter 10 is arranged in an exhaust passage 6 of a diesel engine body 2. The particulate filter 10 carries NOx absorbent 26. In the case of operation in the low-temperature combustion condition where the particulate are accumulated, an additive, including the alkali metal element and alkali earth metal element, is supplied from an additive supplying device 12, so that the particulates caught by the particulate filter can be made to burn even at low-temperature conditions.



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CLAIMS

[Claim(s)]
[Claim 1] The exhaust emission control device of the internal combustion engine characterized by having the additive feeder which adds the additive containing alkali metals or an alkaline earth metal element to the upstream of said particulate filter while having arranged the particulate filter which supports the catalyst which has an oxidization function to an internal combustion engine's flueway, and carries out uptake of the particulate in exhaust gas to it.
[Claim 2] Said additive feeder is an exhaust emission control device of the internal combustion engine according to claim 1 characterized by adding said additive when a particulate accumulates on said particulate filter and it judges that it is the case where have a particulate deposition judging means to judge ******, and a particulate accumulates with this particulate deposition judging means.
[Claim 3] Said particulate deposition judging means is the exhaust emission control device of the internal combustion engine according to claim 2 characterized by judging with it being the case where a particulate accumulates when the differential pressure value which was equipped with a differential pressure detection means to detect the differential pressure of the exhaust air pressure of the upstream of a particulate filter and the downstream exhaust air pressure of a particulate filter, and was detected by this differential pressure detection means is larger than a predetermined value.
[Claim 4] The temperature sensor which detects the temperature of the heat which generates said particulate deposition judging means by operation of an internal combustion engine, An amount calculation means of smoked combustion to compute the amount of smoked combustion which burns in exhaust gas from the temperature detected from this temperature sensor, It has the smoked sensor which detects the smoked discharge in the flueway of the upstream of a particulate filter. The amount of smoked combustion computed by the amount calculation means of smoked combustion and the smoked discharge detected by the smoked sensor are measured. The exhaust emission control device of the internal combustion engine according to claim 2 characterized by judging with it being the case where a particulate accumulates when there are more smoked discharges than the amount of smoked combustion.
[Claim 5] The exhaust emission control device of the internal combustion engine according to claim 1 characterized by to perform the rich spike control which makes the air-fuel ratio of exhaust gas rich with said Air Fuel Ratio Control means when it is judged that it has an operational-status detection means detect said internal combustion engine's operational status, and an Air Fuel Ratio Control means control the air-fuel ratio of exhaust gas, an additive is added by said additive feeder when it is judged that an internal combustion engine is inside load operating with an operational-status detection means, and an internal combustion engine is during low load driving.
[Claim 6] Said additive feeder is an exhaust emission control device of the internal combustion engine according to claim 1 characterized by adding an additive at an internal combustion engine's combustion anaphase.
[Claim 7] Said additive feeder is an exhaust emission control device of the internal combustion engine according to claim 6 characterized by supplying an additive directly in a cylinder.
[Claim 8] Said additive feeder is an exhaust emission control device of the internal combustion engine according to claim 2 characterized by adding an additive in the fuel injected by the internal combustion engine when it judges that it is the case where a particulate accumulates with a particulate deposition judging means.
[Claim 9] Said additive feeder is an exhaust emission control device of the internal combustion engine according to claim 1 characterized by adding an additive within [of an internal combustion engine] inhalation of air.
[Claim 10] The exhaust emission control device of the internal combustion engine according to claim 1 to 9 which will be characterized by being the internal combustion engine which will be in the low-temperature combustion condition [the fuel at the time of the combustion in a combustion chamber and gas ** of the perimeter become lower than the generation temperature of soot, and / soot] no longer generating almost if the yield of soot will increase gradually and will reach a peak if the internal combustion engine increases the amount of inert gas of a combustion chamber, and the amount of inert gas of a combustion chamber is increased further.

[Claim 11] The exhaust emission control device of the internal combustion engine according to claim 10 which has an Air Fuel Ratio Control means to control the air-fuel ratio of exhaust gas, performs rich spike control which makes the air-fuel ratio of exhaust gas rich with said Air Fuel Ratio Control means to the low exhaust gas temperature degree hour at the time of low-temperature combustion, and is characterized by adding an additive by said additive feeder at an exhaust gas temperature degree hour higher than it.
[Claim 12] The exhaust emission control device of the internal combustion engine according to claim 10 or 11 with which it has recycling equipment which carries out recycling of the exhaust gas discharged from the combustion chamber into an engine inhalation-of-air path, and said inert gas consists of recycling exhaust gas.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the exhaust emission control device which performs uptake of the particle under exhaust air of internal combustion engines, such as a diesel power plant, concerning an internal combustion engine's exhaust emission control device.
[0002]
[Description of the Prior Art] As this kind of an exhaust emission control device, to JP,6-159037,A It is NOx when the air-fuel ratio of inflow exhaust air is Lean. NOx absorbed when it absorbed and the oxygen density of inflow exhaust air fell NOx to emit An absorbent is arranged to the flueway of a diesel power plant, and it is NOx under exhaust air. It is made to absorb. The account NOx of back to front NOx which supplied and absorbed the reducing agent to the absorbent Said NOx NOx emitted while making it emit from an absorbent In the exhaust emission control device which carries out reduction purification Said NOx The particulate filter which carries out uptake of the particle under exhaust air to an absorbent is arranged in the location which can be heat-transferred mutually. Said NOx A reducing agent is supplied to an absorbent and it is said NOx. After performing emission and reduction purification, the exhaust emission control device of the internal combustion engine characterized by making it burn the particulate by which uptake was carried out to said particulate filter is indicated.
[0003] With this equipment, it is NOx. It is NOx when a reducing agent is supplied to an absorbent. A reducing agent burns on an absorbent and it is NOx. Since the ambient atmosphere oxygen density of an absorbent falls, it is NOx. An absorbent to NOx It is emitted and reduction purification is carried out with a reducing agent. At this time, it is NOx. As for an absorbent, temperature rises by combustion of a reducing agent. A particulate filter is NOx. Since it is arranged in the location which can be heat-transferred to an absorbent and mutual, a particulate filter is NOx. Temperature rises in response to the heat of an absorbent. For this reason, in case a particulate filter is reproduced, the particulate filter is sufficient elevated temperature, and particulate ignition combustion is performed easily, without supplying great energy from the outside.
[0004]
[Problem(s) to be Solved by the Invention] However, with such equipment, an exhaust-gas temperature is low, and when a particulate filter is low temperature, the particulate combustion by which uptake was carried out is not promoted.
[0005] Then, although it is possible to raise exhaust gas temperature preparing an exhaust valve in a flueway, extracting exhaust air, and raising exhaust air pressure, it is thermally difficult to prepare an exhaust valve.
[0006] In view of the above-mentioned problem, this invention makes it a technical problem to enable it to reproduce a particulate filter easily, even if an exhaust-gas temperature is in a low-temperature condition.
[0007]
[Means for Solving the Problem] The following means were used for this invention in order to solve said technical problem. That is, in an internal combustion engine's exhaust emission control device, this invention is equipped with the additive feeder which adds the additive containing alkali metals or an alkaline earth metal element to the upstream of said particulate filter while it arranges the particulate filter which supports the catalyst which has an oxidization function in an internal combustion engine's flueway, and carries out uptake of the particulate in exhaust gas.
[0008] The particulate filter is supporting the catalyst which has an oxidation function. As a catalyst which has an oxidation function, it is an oxidation catalyst or a three way component catalyst, for example, and these are supported on the porosity ceramic.
[0009] An additive feeder adds the additive containing alkali metals or an alkaline earth metal element to the upstream

of said particulate filter. Alkali metals are a lithium, sodium, a potassium, a rubidium, caesium, and a francium.
[0010] Alkaline earth metal elements are beryllium, magnesium, calcium, strontium, barium, radium, etc. These combine with the soot (carbon) which constitutes a particulate, and the oxygen in exhaust gas, for example, a potassium turns into potassium carbonate and is discharged. And since this oxidation reaction is possible in the state of low temperature, particulate combustion becomes possible in the state of a low exhaust-gas temperature.
[0011] It is good to add said additive here, when it judges that said additive feeder is the case where have a particulate deposition judging means to judge ****** when a particulate accumulates on said particulate filter, and a particulate accumulates with this deposition judging means.
[0012] Said particulate deposition judging means is equipped with a differential pressure detection means to detect the differential pressure of the exhaust air pressure of the upstream of a particulate filter, and the downstream exhaust air pressure of a particulate filter, and when the differential pressure value detected by this differential pressure detection means is larger than a predetermined value, it judges with it being the case where a particulate accumulates.
[0013] As other examples of said particulate deposition judging means For example, the temperature sensor which detects the temperature of the heat generated by operation of an internal combustion engine, for example, exhaust gas temperature, An amount calculation means of smoked combustion to compute the amount of smoked combustion which burns in exhaust gas from the temperature detected from this temperature sensor, It has the smoked sensor which detects the smoked discharge in the flueway of the upstream of a particulate filter. The amount of smoked combustion computed by the amount calculation means of smoked combustion and the smoked discharge detected by the smoked sensor are measured, and when there are more smoked discharges than the amount of smoked combustion, it judges with it being the case where a particulate accumulates.
[0014] Furthermore, while having an operational status detection means to detect an internal combustion engine's operational status, it has an Air Fuel Ratio Control means to control the air-fuel ratio of exhaust gas, and you may make it change the technique of regeneration according to the operational status of the internal combustion engine which detected with the operational status detection means.
[0015] For example, when it is judged that an internal combustion engine is inside load operating with an operational status detection means, an additive is added by said additive feeder, and when it is judged that an internal combustion engine is during low load driving, it is made to perform rich spike control which makes the air-fuel ratio of exhaust gas rich with said Air Fuel Ratio Control means. The change in the injection quantity of the fuel injection injected by the combustion chamber or injection of the fuel to a flueway performs Air Fuel Ratio Control of exhaust gas.
[0016] Said additive feeder adds an additive at an internal combustion engine's combustion anaphase (second half like an expansion line), or adds an additive in the fuel for an internal combustion engine.
[0017] The meaning which adds an additive at an internal combustion engine's combustion anaphase (second half like an expansion line) is for mixing an additive and making it supplied from a flueway into exhaust gas at a particulate filter. In this case, it is desirable to prepare the additive feeder which supplies an additive directly in a cylinder. If an additive is directly supplied in a cylinder, particulate generating in combustion gas can be pressed down.
[0018] Moreover, if an additive is added in the fuel injected by the internal combustion engine when it judges that it is the case where a particulate accumulates with a particulate deposition judging means, since a particulate oxidizing quality will improve, the particulate amount discharged by the internal combustion engine decreases. Since the particulate flammability in a particulate filter also improves to coincidence, the pressure drop buildup of a particulate filter can be controlled.
[0019] You may make it said additive feeder add an additive within [of not only adding an additive for an additive to the flueway of the upstream of a particulate filter but an internal combustion engine] inhalation of air.
[0020] Since it will become the same with having added the additive in the fuel as a result and the particulate oxidizing quality to generate will improve if an additive is added within inhalation of air, the particulate amount discharged by the internal combustion engine decreases. Moreover, since the particulate flammability in a particulate filter also improves, the pressure drop buildup of a particulate filter can be controlled.
[0021] If this invention is applied to the internal combustion engine which will be in the low-temperature combustion condition [the fuel at the time of the combustion in a combustion chamber and gas ** of the perimeter become lower than the generation temperature of soot, and / soot] no longer generating almost if the yield of soot will increase gradually and will reach a peak if the amount of inert gas of a combustion chamber is increased, and the amount of inert gas of a combustion chamber is increased further, it is suitable.
[0022] In such an internal combustion engine, it has an Air Fuel Ratio Control means to control the air-fuel ratio of exhaust gas, rich spike control which makes the air-fuel ratio of exhaust gas rich with said Air Fuel Ratio Control means is performed to the low exhaust gas temperature degree hour at the time of low-temperature combustion, and an additive

is added by said additive feeder to an exhaust gas temperature degree hour higher than it.

[0023] When the yield of soot will increase gradually and will reach a peak, if the amount of inert gas of an internal combustion engine's combustion chamber is increased, and the amount of inert gas of a combustion chamber is increased further, the fuel at the time of the combustion in a combustion chamber and gas ** of the perimeter become lower than the generation temperature of soot, and soot stops almost generating. Although this condition is called low-temperature combustion condition, in order to do in this way, it is good to have recycling equipment which carries out recycling of the exhaust gas discharged from an internal combustion engine's combustion chamber into an engine inhalation-of-air path. In this case, said inert gas consists of recycling exhaust gas. Each above configuration is combinable as much as possible.

[0024]

[Embodiment of the Invention] The 1st example of this invention is shown in <example 1> drawing 1 . In drawing 1 , in 2, a diesel power plant and 4 show an inhalation-of-air path, and 6 shows a flueway, respectively. NOx as the catalyst which the inhalation-of-air throttle valve 8 is formed in the inhalation-of-air path 4, and has an oxidization function in a flueway 6, for example, a three way component catalyst, The PATIKYURA filter 10 which supported the absorbent is arranged. At the time, it considers as full open and this inhalation-of-air throttle valve 8 is usually NOx like the after-mentioned. In case an absorbent is reproduced, clausilium is carried out, an internal combustion engine's 2 inhalation air content is extracted, and it is NOx. The exhaust air flow rate which flows into an absorbent is reduced. It is the actuator of proper formats, such as a solenoid which drives the inhalation-of-air throttle valve 8, and a negative pressure actuator, which is shown in drawing by 16.

[0025] In the middle of the flueway 6, the additive feeder 12 for supplying an additive is formed in the flueway 6 at the particulate filter 10 upstream. In this example, the solution which dissolved alkaline-earth-metal elements, such as alkali metals, such as a lithium, sodium, a potassium, a rubidium, caesium, and a francium, and beryllium, magnesium, calcium, strontium, barium, radium, in the organic solvent is used as an additive. The additive feeder 12 is equipped with the nozzle which injects an additive in the shape of a fog in a flueway 6.

[0026] An exhaust gas temperature sensor 14 is arranged in the flueway 6 between a particulate filter 10 and the additive feeder 12, and the detecting signal of this exhaust gas temperature sensor 14 is inputted into an electronic control unit (ECU) 30. Consist of a digital computer of a well-known format which connected CPU (central processing unit), RAM (random access memory), ROM (read-only memory), and input/output port with the bi-directional bus, and basic control of internal combustion engines, such as fuel-oil-consumption control, is performed, and also ECU30 is NOx at this example. Control of playback of an absorbent, particulate combustion, etc. is also performed.

[0027] For these control, ECU30 controls the actuator 16, the additive feeder 12, and reducing-agent feeder 12b which drive the inhalation-of-air throttle valve 8, and adjusts reducing-agent supply from accommodation and reducing-agent feeder 12b of closing motion of the inhalation-of-air throttle valve 8, and the additive supply from the additive feeder 12.

[0028] An electronic control unit (ECU) 30 functions also as Air Fuel Ratio Control means 30a, and is NOx. For regeneration of an absorbent, the fuel oil consumption from a fuel injection valve is controlled, and rich spike control which makes an air-fuel ratio rich and makes exhaust gas temperature high is performed.

[0029] Moreover, ECU30 functions also as operational status detection means 30b which detects an engine rotational frequency, the temperature of torque and an engine, etc., and judges operational status. Various kinds of control is performed according to the detection result in operational status detection means 30b.

[0030] The expanded sectional view of a particulate filter 10 is shown in drawing 2 . If drawing 2 is referred to, a particulate filter 10 will consist of a porosity ceramic, and exhaust gas will flow toward the right from ******, as shown by the arrow head. In the particulate filter 10, the 1st path 22 where the plug 18 was given to the upstream, and the 2nd path 24 where the plug 20 was given to the downstream are arranged by turns, and the shape of a honeycomb is made. If exhaust gas flows toward the right from ******, exhaust gas will pass the passage wall surface of a porosity ceramic from the 2nd path 24, will flow into the 1st path 22, and will flow to the downstream. At this time, uptake of the particulate in exhaust gas is carried out by the porosity ceramic, and it prevents emission to particulate atmospheric air by it.

[0031] In the wall surface of the 1st and 2nd paths 22 and 24, it is NOx. The absorbent 26 is supported. NOx An absorbent 26 consists of at least one chosen from Potassium K, Sodium Na, Lithium Li, alkali metal like Caesium Cs, Barium Ba, an alkaline earth like Calcium calcium, Lanthanum La, and rare earth like Yttrium Y, and noble metals like Platinum Pt. NOx An absorbent 26 is NOx when the air-fuel ratio of inflow exhaust gas is Lean. NOx which was absorbed, and was absorbed when the oxygen density in inflow exhaust gas fell NOx to emit An absorption/emission action is performed.

[0032] Above-mentioned NOx It will use this NOx if an absorbent 26 is arranged in an engine flueway. An absorbent 26 is actually NOx. Although an absorption/emission action is performed, there is also a part which is not clear about the detailed mechanism of this absorption/emission action. However, it is thought that this absorption/emission action is performed by the mechanism as shown in drawing 3 . Next, it becomes the same mechanism even if it uses other noble metals, alkali metal, an alkaline earth, and rare earth, although this mechanism is explained taking the case of the case where Platinum Pt and Barium Ba are made to support.

[0033] That is, as the oxygen density in inflow exhaust gas will increase sharply if inflow exhaust gas becomes Lean considerably, and shown in drawing 3 (A), it is these oxygen O2. It adheres to the front face of Platinum Pt in the form of O2- or O2-. On the other hand, NO contained in inflow exhaust gas reacts with O2- or O2- on the front face of Platinum Pt, and is NO2. It becomes (2 NO+O2 ->2NO2).

[0034] Subsequently, a part of generated NO2 is NOx, oxidizing further on Platinum Pt. As shown in drawing 3 (A), being absorbed in an absorbent 26 and combining with the barium oxide BaO, it is NOx in the form of nitrate ion NO3-. It is spread in an absorbent 26. Thus, NOx NOx It is absorbed in an absorbent 26.

[0035] As long as the oxygen density in inflow exhaust gas is high, NO2 is generated on the front face of Platinum Pt, and it is NOx. NOx of an absorbent 26 NO2 is NOx unless absorptance is saturated. It is absorbed in an absorbent 26 and nitrate ion NO3- is generated. On the other hand, when the oxygen density in inflow exhaust gas falls and the amount of generation of NO2 falls, a reaction goes to hard flow (NO3-->NO2), and it is NOx thus. Nitrate ion NO3- in an absorbent 26 is emitted from an absorbent in the form of NO2. That is, it is NOx if the oxygen density in inflow exhaust gas falls. From an absorbent 26 to NOx It will be emitted. It will be NOx if the oxygen density in inflow exhaust gas will fall if the degree of Lean of inflow exhaust gas becomes low, therefore the degree of Lean of inflow exhaust gas is made low. From an absorbent 26 to NOx It will be emitted.

[0036] On the other hand, when the air-fuel ratio of inflow exhaust gas is made rich at this time, HC and CO react with oxygen O2- on Platinum Pt, or O2-, and are made to oxidize. if the air-fuel ratio of inflow exhaust gas is made rich, in order [moreover,] for the oxygen density in inflow exhaust gas to fall to the degree of pole -- the NOx absorbent 26 to NO2 it emits -- having -- this NO2 it is shown in drawing 3 (B) -- as -- unburnt -- it reacts with HC and CO and reduction purification is carried out. Thus, it is NOx when NO2 stops existing on the front face of Platinum Pt. It is NO2 from an absorbent 26 to the degree from a degree. It is emitted. Therefore, if the air-fuel ratio of inflow exhaust gas is made rich, it is the NOx absorbent 26 to NOx to the inside of a short time. Reduction purification will be emitted and carried out. Since the diesel power plant is used in this example, the exhaust air air-fuel ratio at the time of operation is usually Lean, and it is NOx. An absorbent 26 is NOx under exhaust air. It absorbs. Moreover, the air-fuel ratio of the exhaust gas which will pass a particulate filter 10 if fuel injection to a combustion chamber is carried out or a fuel is supplied to the flueway 6 of the particulate filter 10 upstream as a reducing agent becomes rich, and is NOx. The above NOx from an absorbent 26 Emission and reduction are performed. This control is called rich spike control. Moreover, as for the reducing agent to supply, the fuel of a diesel power plant 2 is used. Suppose that rich spike control is carried out by the fuel injection to a combustion chamber by Air Fuel Ratio Control means 30a by this example. In addition, the air-fuel ratio of exhaust air here is NOx. The ratio of the air and the fuel which were supplied to the flueway 6, engine combustion chamber, or inhalation-of-air path of the absorbent 26 upstream shall be said. Therefore, when neither air nor a reducing agent is supplied to the flueway 6, an exhaust air air-fuel ratio becomes equal to an internal combustion engine's operation air-fuel ratio (combustion air-fuel ratio of an engine combustion chamber). Next, actuation of this example is explained, referring to drawing 4 . Drawing 4 is NOx. It is the flow chart which shows the control routine of the particulate combustion by which uptake was carried out to playback and the particulate filter 10 of an absorbent 26.

[0037] For this control, the service condition which particulate deposition judging means 30c is realized on ECU30, and PATIKYURAMATA deposits on ROM (read-only memory) of ECU30 at a particulate filter 10 is memorized in the form of a map in the relation between an engine speed and an engine load (torque), as shown in drawing 5 .

[0038] Particulate deposition judging means 30c realized on ECU30 performs a particulate deposition judging with reference to the map memorized by this ROM. It is [the field which PATIKYURAMATA deposits on a particulate filter 10 in the relation between an engine speed and an engine load (torque) like / it is ****** and / from this map, the field in which a particulate continuous combustion is possible, and] NOx by rich spike. The field which can reproduce an absorbent exists. Such a field is found out from the rule of thumb on operation of an internal combustion engine.

[0039] The routine shown in drawing 4 is performed by ECU30 by the interruption for every fixed time amount. First, when it judges whether it is the field which a particulate deposits on a particulate filter 10 with reference to a map from the engine speed inputted into ECU30, and torque and is in the field at step 10, it progresses to step 20 and an additive is injected from the additive feeder 12. Moreover, the inhalation-of-air throttle valve 8 is opened by coincidence. A lot of air flows in a particulate filter 10 by this. Therefore, it is lit by the particulate by which uptake was carried out to the

particulate filter 10. In addition, although not illustrated, auxiliary heating means, such as an electric heater, are formed in the particulate filter 10 upstream, and particulate ignition will be promoted if a particulate filter 10 is heated. HC which was here offered as an additive, for example and from which Potassium K constitutes a particulate, for example, and supplied oxygen O_2 It joins together, and like the following formula, it becomes potassium carbonate and is discharged.

$2m\text{-}K+C_mH_n+ \{(6 m+n) /4\} O_2 \rightarrow m\text{-}K_2CO_3+(n/2) H_2O$ (m and n are the natural number)

If alkali metal and an alkaline earth metal are added, a particulate can be burned at temperature lower than the usual combustion temperature. If it puts in another way, also in the time of a low exhaust-gas temperature, I hear that particulate combustion is possible and it is. Conversely, if it says, since it will be easy to deposit a particulate at the time of exhaust air low temperature, it can be said that addition of an additive is effective. When PATIKYURAMATA is not the field deposited on a particulate filter 10, although it is the case of heavy load operation or low load driving, it progresses to step 30 from that case. At step 30, it is NOx by rich spike. It is judged whether it is the field which can reproduce an absorbent.

[0040] At step 30, it is NOx by rich spike. It is NOx when judged with it being the field which can reproduce an absorbent. Rich spike control is performed for the absorbent playback start condition being equipped as a premise. NOx It is an absorbent playback start condition for example, at the moderation time, and it is NOx. An absorbent 26 is more than activation temperature, and after performing playback last time, it is having passed beyond predetermined time etc. These are based on decision of operational status detection means 30b.

[0041] NOx When judged with the absorbent playback start condition not being satisfied, processing is ended without performing rich spike control. NOx If it is the case where an absorbent playback start condition is satisfied, rich spike control will be performed at step 40. Here, clausilium of the inhalation-of-air throttle valve 8 is carried out. The air content which flows into a particulate filter 10 by this decreases. Subsequently, the fuel oil consumption in an internal combustion engine's combustion chamber is increased, and an exhaust air air-fuel ratio is made rich. Or a fuel is injected from the reducing-agent feeder prepared separately to a flueway as a reducing agent. The fuel is NOx. It burns by the catalysis of an absorbent 26 and the oxygen in exhaust gas is consumed.

[0042] For this reason, the oxygen density in the exhaust gas in a particulate filter 10 falls to the degree of pole, and the air-fuel ratio of exhaust gas becomes rich. By this, it is NOx as mentioned above. From an absorbent 26 to NOx It is emitted and is this emitted NOx. Reduction purification will be carried out. In addition, since an exhaust-gas temperature rises by rich spike control, a particulate burns and a particulate filter is reproduced.

[0043] In addition, instead of controlling fuel oil consumption for rich spike control, as described above It is NOx to the flueway 6 of the particulate filter 10 upstream. When preparing separately the reducing-agent feeder for supplying the reducing agent used for playback of an absorbent, as a reducing agent That what is necessary is just what is exhausting and generates reduction components, such as a hydrocarbon and a carbon monoxide, although liquid fuel, such as a hydrocarbon of liquids, such as gases, such as hydrogen and a carbon monoxide, a propane, a propylene, and butane, or a gas, a gasoline, gas oil, and kerosene, etc. can be used In order to avoid the complicatedness in the cases, such as storage and supply, a good target uses the gas oil which is the fuel of a diesel power plant 2 as a reducing agent.

[0044] As explained above, combustion of the particulate [time / of a particulate deposition field, ********, and inside load operation] in addition of an additive is NOx by rich spike control in the field of a low load [it] in ****. Particulate combustion is attained at playback and coincidence of an absorbent, and the suitable particulate filter according to operational status can be regenerated.

[0045] <Example 2> Next drawing 6 is used and the 2nd example of this invention is explained. Particulate deposition judging means 30c which judges whether it is the field which PATIKYURAMATA deposits on a particulate filter 10 here is realized on ECU30, pressure sensors 10a and 10b are formed in the upstream and the downstream of a particulate filter 10, respectively, and both differential pressure is measured by differential-pressure-gage 10c, and when it is judged that the differential pressure value detected by differential-pressure-gage 10c is larger than a predetermined value, it judges with it being the case where a particulate accumulates.

[0046] That is, 30d of differential pressure detection means equipped with the pressure sensors 10a and 10b formed in the upstream and the downstream of a particulate filter 10 and differential-pressure-gage 10c is realized on ECU30. In addition, 12a is an injection valve which constitutes an additive feeder, and 12b is a pump which feeds an additive. Since other configurations are the same as that of an example 1, the explanation is omitted. In addition, when a pressure sensor is formed only in the upstream of a particulate filter 10 and the measurement value becomes more than predetermined, you may judge with it being the case where a particulate accumulates. It is because the back pressure of the upstream will rise if a particulate accumulates on a particulate filter 10.

[0047] As <example 3> drawing 7 showed, particulate deposition judging means 30c which judges whether it is the

field which PATIKYURAMATA deposits on a particulate filter 10 is realized on ECU30 here. And it has 10d of temperature sensors which detect the temperature of the exhaust air heat generated by operation of an internal combustion engine, and smoked sensor 10e which detects the smoked discharge in the flueway of the upstream of a particulate filter. These sensors are connected to ECU30. On ECU30, amount calculation means of smoked combustion 30e which computes the amount of smoked combustion which burns in exhaust gas from the exhaust-gas temperature detected from 10d of temperature sensors is realized.

[0048] Particulate deposition judging means 30c measures the amount of smoked combustion computed by amount calculation means of smoked combustion 30e, and the smoked discharge detected by smoked sensor 10e, and when there are more smoked discharges than the amount of smoked combustion, it judges with it being the case where a particulate accumulates. Since other configurations are the same as that of an example 1, the explanation is omitted.

[0049] <Example 4> When judged with it being the field which PATIKYURAMATA deposits on a particulate filter 10 by particulate deposition judging means 30c like each example which was equipped with injection valve 12a and pump 12b, pumped up the additive by pump 12b as shown in drawing 8 , formed the additive feeder 12 for injecting and supplying from injection valve 12a in the cylinder, and was described above here, an additive is injected directly into a cylinder at an internal combustion engine's combustion anaphase.

[0050] If it does in this way, since the particulate amount which particulate oxidization progresses at a combustion anaphase and is discharged by the internal combustion engine not only decreases, but the particulate flammability in a particulate filter will improve, the pressure drop buildup of a particulate filter can be controlled. In addition, 2a is a fuel injection valve.

[0051] <Example 5> It is what supplied the additive to the fuel-injection system which supplies a fuel in a cylinder through fuel injection valve 2a by fuel pump 2c from fuel tank 2b in pump 12b here as shown in drawing 9 . Like an example 1 from information, such as an internal combustion engine's rotational frequency and torque Or when judged with it being the field which PATIKYURAMATA deposits on a particulate filter 10 with a particulate deposition judging means by the example 2 or approach like 3, It is the example which opens electromagnetic-control valve 12c prepared between a fuel pump and pump 12b for additive addition, mixes an additive to a fuel, and was injected in the cylinder from fuel injection valve 2a.

[0052] Thus, if an additive is added in a fuel, since a particulate oxidizing quality will improve, the particulate amount discharged by the internal combustion engine decreases. Moreover, since the particulate flammability in a particulate filter also improves, the pressure drop buildup of a particulate filter can be controlled.

[0053] <Example 6> When judged with it being the field which PATIKYURAMATA deposits on a particulate filter 10 by particulate deposition judging means 10c like each example which was equipped with injection valve 12a and pump 12b, pumped up the additive by pump 12b as shown in drawing 10 , formed the additive feeder 12 for injecting and supplying from injection valve 12a in the inlet pipe 4, and was described above here, an additive is injected within inhalation of air.

[0054] The effectiveness is the same as an example 5. That is, since the particulate oxidizing quality to generate as well as [if an additive is injected within inhalation of air, since a fuel will be injected by the new mind containing an additive] the case where a fuel adds an additive in a fuel improves, the particulate amount discharged by the internal combustion engine decreases. Moreover, since the particulate flammability in a particulate filter also improves, the pressure drop buildup of a particulate filter can be controlled.

[0055] <Example 7> If this invention is applied to the internal combustion engine which will be in the low-temperature combustion condition [the fuel at the time of the combustion in a combustion chamber and gas ** of the perimeter become lower than the generation temperature of soot, and / soot] no longer generating almost if the yield of soot will increase gradually and will reach a peak if the amount of inert gas of a combustion chamber is increased, and the amount of inert gas of a combustion chamber is increased further, it is suitable.

[0056] In such an internal combustion engine, it has an Air Fuel Ratio Control means to control the air-fuel ratio of exhaust gas, rich spike control which makes the air-fuel ratio of exhaust gas rich with said Air Fuel Ratio Control means is performed to the low exhaust gas temperature degree hour at the time of low-temperature combustion, and an additive is added by said additive feeder to an exhaust gas temperature degree hour higher than it. That is, the field in the map of drawing 5 which can be spiked rich is the former, and a particulate deposition field serves as the latter.

[0057] When the yield of soot will increase gradually and will reach a peak, if the amount of inert gas of an internal combustion engine's combustion chamber is increased, and the amount of inert gas of a combustion chamber is increased further, the fuel at the time of the combustion in a combustion chamber and gas ** of the perimeter become lower than the generation temperature of soot, and soot stops almost generating. Although this condition is called low-temperature combustion condition, the recycling equipment which carries out recycling of the exhaust gas discharged

from an internal combustion engine combustion chamber into an engine inhalation-of-air path as a ** operation gestalt which realizes such a low-temperature combustion condition, i.e., EGR equipment, can be illustrated.
[0058] The example of the internal combustion engine having such EGR equipment is shown in drawing 11 . Drawing 11 shows 4 stroke compression ignition type internal combustion engine. if drawing 11 is referred to -- 1 -- an engine body and 102 -- a cylinder block and 103 -- the cylinder head and 104 -- a piston and 105 -- in an inlet valve and 108, a suction port and 109 show an exhaust valve and, as for a combustion chamber and 106, 110 shows [an electric control type fuel injection valve and 107] an exhaust air port, respectively. A suction port 108 is connected with a surge tank 112 through the corresponding inhalation-of-air branch pipe 111, and a surge tank 112 is connected with an air cleaner 114 through an air intake duct 113. In an air intake duct 113, the throttle valve 116 driven by the electric motor 115 is arranged. On the other hand, it connects with a particulate filter 119 through an exhaust manifold 117 and an exhaust pipe 118, and the exhaust air port 110 is NOx in the lower stream of a river of a particulate filter 119. An absorbent 120 is arranged.
[0059] As shown in drawing 11 , the air-fuel ratio sensor 121 is arranged in an exhaust manifold 117. An exhaust manifold 117 and the surge tank 112 of each other are connected through the EGR path 122, and the electric control type EGR control valve 123 is arranged in the EGR path 122. Moreover, the cooling system 124 for cooling the EGR gas which flows the inside of the EGR path 122 is arranged at the circumference of the EGR path 122. the example shown in drawing 11 -- engine cooling water -- the inside of a cooling system 124 -- **** -- EGR gas is cooled with him and engine cooling water.
[0060] On the other hand, each fuel injection valve 106 is connected with a fuel reservoir and the so-called common rail 126 through a fuel feeding pipe 125. The fuel which the fuel was supplied into this common rail 126 from the strange fuel pump 127 with the good discharge quantity of an electric control type, and was supplied in the common rail 126 is supplied to a fuel injection valve 106 through each fuel feeding pipe 125. The fuel pressure sensor 128 for detecting the fuel pressure in a common rail 126 to a common rail 126 is attached, and the discharge quantity of a fuel pump 127 is controlled so that the fuel pressure in a common rail 126 turns into target fuel pressure based on the output signal of the fuel pressure sensor 128.
[0061] An electronic control unit 130 consists of a digital computer, and ROM (read-only memory)132, RAM (random access memory)133, CPU (microprocessor)134, the input port 135, and the output port 136 which were mutually connected by the bidirectional bus 131 are provided. The output signal of the air-fuel ratio sensor 121 is inputted into input port 135 through corresponding A-D converter 137, and is inputted into input port 135 through A-D converter 137 to which the output signal of the fuel pressure sensor 128 also corresponds. The load sensor 141 which generates the output voltage proportional to the amount L of treading in of an accelerator pedal 140 is connected to an accelerator pedal 140, and the output voltage of the load sensor 141 is inputted into input port 135 through corresponding A-D converter 137. Moreover, whenever 30 degrees rotates, the crank angle sensor 142 which generates an output pulse is connected to input port 135 for a crankshaft. On the other hand, an output port 136 is connected to a fuel injection valve 106, an electric motor 115, the EGR control valve 123, and a fuel pump 127 through the corresponding drive circuit 138.
[0062] Drawing 12 is change of the output torque when changing air-fuel ratio A/F (axis of abscissa of drawing 12) and a smoke, and HC, CO and NOx by changing the opening and the EGR rate of a throttle valve 116 at the time of engine low load driving. The example of an experiment which shows change of a discharge is expressed. An EGR rate becomes large, so that drawing 12 may show, and air-fuel ratio A/F becomes small in this example of an experiment, and at the time of below theoretical air fuel ratio (**14.6), the EGR rate has become 65% or more.
[0063] As shown in drawing 12 , when air-fuel ratio A/F was made small by increasing an EGR rate, an EGR rate becomes the neighborhood 40% and air-fuel ratio A/F becomes about 30, the yield of a smoke starts increase. Subsequently, if an EGR rate is raised further and air-fuel ratio A/F is made small, the yield of a smoke will increase rapidly and will reach a peak. Subsequently, a smoke will be set to about 0 if a smoke will fall rapidly shortly, an EGR rate will be made into 65% or more, if an EGR rate is raised further and air-fuel ratio A/F is made small, and air-fuel ratio A/F becomes the 15.0 neighborhoods. Soot stops namely, almost generating. At this time, power torque falls a little and is NOx. An yield becomes quite low. On the other hand, the yield of HC and CO begins to increase at this time.
[0064] Air-fuel ratio A/F shows the combustion pressure change in the combustion chamber 5 when there are most yields of a smoke in the 18 neighborhoods, and, as for drawing 13 (A), air-fuel ratio A/F shows change of the combustion pressure in the combustion chamber 5 in case the yield of a smoke is about 0 in the 13 neighborhoods, as for drawing 13 (B). When it is shown in drawing 13 (B) whose yield of a smoke is about 0 so that it may understand, if drawing 13 (A) is compared with drawing 13 (B), compared with the case where it is shown in drawing 13 (A) with many yields of a smoke, it turns out that combustion pressure is low.

[0065] The following thing can be said from the experimental result shown in drawing 12 and drawing 13 . That is, first, air-fuel ratio A/F is NOx, as it shown in the 1st at drawing 12 , when the yield of a smoke is about 0 or less in 15.0. An yield falls considerably. NOx It can be said to be that the combustion temperature in a combustion chamber 105 is low that the yield fell, when it means that the combustion temperature in a combustion chamber 105 is falling, therefore soot is hardly generated. The same thing can say also from drawing 13 . That is, in the condition which shows in drawing 13 (B) which soot has hardly generated, combustion pressure is low, therefore the combustion temperature in a combustion chamber 105 will be low at this time.

[0066] If the yield of a smoke, i.e., the yield of soot, is set [2nd] to about 0, as shown in drawing 12 , the discharge of HC and CO will increase. It means that this is discharged without a hydrocarbon growing even to soot. That is, it will pyrolyze, if the temperature rise of a straight chain hydrocarbon and aromatic hydrocarbon as shown in drawing 14 contained in a fuel is carried out in the condition that oxygen is insufficient, and the precursor of soot is formed, and the soot which consists of a solid-state with which carbon atoms subsequently mainly gathered is generated. In this case, although the generation process of actual soot is complicated and it is not clear what kind of gestalt the precursor of soot takes, a hydrocarbon as shown anyway in drawing 14 will grow even to soot through the precursor of soot. Therefore, although the discharge of HC and CO will increase as shown in drawing 12 if the yield of soot is set to about 0 as mentioned above, HC at this time is the precursor of soot, or the hydrocarbon of the condition before that. When these considerations based on the experimental result shown in drawing 12 and drawing 13 are summarized, when the combustion temperature in a combustion chamber 105 is low, the yield of soot is set to about 0, and the precursor of soot or the hydrocarbon of the condition before that will be discharged from a combustion chamber 105 at this time. As a result of repeating experiment research in a detail further about this, when the fuel in a combustion chamber 105 and the gas temperature of that perimeter were below a certain temperature, the growth process of soot stopped on the way, soot was not generated at all but the fuel in a combustion chamber 105 and the temperature of that perimeter became beyond a certain temperature, it became clear that soot was generated.

[0067] by the way -- although it cannot say what times it is since a fuel in case the generation process of a hydrocarbon stops in the state of the precursor of soot and the temperature of that perimeter, i.e., a certain above-mentioned temperature, change with various factors, such as a class of fuel, an air-fuel ratio, and a compression ratio, -- this temperature of a certain -- NOx an yield and close relation -- having -- **** -- therefore, this temperature of a certain -- NOx from an yield -- being certain -- an extent convention can be carried out. That is, the fuel at the time of combustion and the gas temperature of the perimeter fall, so that an EGR rate increases, and it is NOx. An yield falls. At this time, it is NOx. An yield is 10p.p.m. When it becomes less than [order or it], soot stops almost generating. Therefore, a certain above-mentioned temperature is NOx. An yield is 10p.p.m. It is mostly in agreement with the temperature when becoming less than [order or it].

[0068] If soot is generated, this soot cannot once be purified as the after treatment using the catalyst which has an oxidation function is also. On the other hand, the precursor of soot or the hydrocarbon of the condition before that can be easily purified as the after treatment using the catalyst which has an oxidation function is also. Thus, considering the after treatment by the catalyst which has an oxidation function, there is a very big difference about whether a hydrocarbon is made to discharge from a combustion chamber 105 in the precursor of soot, or the condition before that, or it is made to discharge from a combustion chamber 105 in the form of soot.

[0069] Now, it is necessary to control the fuel at the time of the combustion in a combustion chamber 5 in stopping growth of a hydrocarbon in the condition before soot is generated, and the gas temperature of the perimeter to temperature lower than the temperature by which soot is generated. In this case, it has become clear that an endoergic operation of the gas of the circumference of the fuel at the time of a fuel burning controlling the gas temperature of a fuel and its perimeter influences very greatly.

[0070] That is, the fuel which evaporated when only air existed in the circumference of a fuel reacts with the oxygen in air immediately, and burns. In this case, the temperature of the air which is separated from the fuel does not rise so much, but only the temperature of the circumference of a fuel becomes local very high. That is, at this time, the air which is separated from the fuel hardly performs an endoergic operation of the heat of combustion of a fuel. In this case, since combustion temperature becomes local very high, the unburnt hydrocarbon which received this heat of combustion will generate soot.

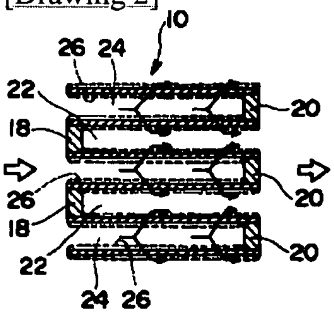
[0071] On the other hand, when a fuel exists in the mixed gas of a lot of inert gas and a small amount of air, situations differ a little. In this case, an evaporation fuel will react with the oxygen which is spread around and intermingled in inert gas, and will burn. In this case, since heat of combustion is absorbed by surrounding inert gas, combustion temperature will not rise so much. That is, combustion temperature can be stopped low. That is, in controlling combustion temperature, the role with important existence of inert gas is played, and combustion temperature can be

low stopped according to an endoergic operation of inert gas.
[0072] In this case, the amount only of inert gas which may absorb sufficient heating value to do so is needed for controlling the gas temperature of a fuel and its perimeter to temperature lower than the temperature by which soot is generated. Therefore, the amount of inert gas which is needed if fuel quantity increases will increase in connection with it. In addition, an endoergic operation becomes powerful, therefore gas of inert gas with the big specific heat will be desirable, so that the specific heat of inert gas is large in this case. This point and CO2 It can be said that it is desirable to use EGR gas as inert gas since the specific heat is comparatively large as for EGR gas.
[0073] Drawing 15 shows the relation between the EGR rate when changing the cooling degree of EGR gas, and a smoke, using EGR gas as inert gas. That is, in drawing 15 , the case where Curve A cooled EGR gas powerfully and EGR gas ** is maintained at about 90 degrees C is shown, Curve B shows the case where EGR gas is cooled with a small cooling system, and Curve C shows the case where EGR gas is not cooled compulsorily.
[0074] If the yield of soot serves as a peak in the place where an EGR rate is somewhat lower than 50% and an EGR rate is made about 55% or more in this case when EGR gas is cooled powerfully, as shown by the curve A of drawing 15 , soot will hardly be generated. If the yield of soot serves as a peak in the place where an EGR rate is somewhat higher than 50% and an EGR rate is made about 65% or more in this case on the other hand when a little EGR gas is cooled, as shown by the curve B of drawing 15 , soot will hardly be generated.
[0075] Moreover, if the yield of soot serves as a peak in the neighborhood whose EGR rate is 55% and an EGR rate is made about 70% or more in this case when EGR gas is not cooled compulsorily, as shown by the curve C of drawing 15 , soot will hardly be generated. In addition, drawing 15 shows the yield of a smoke when an engine load is comparatively expensive, if an engine load becomes small, the EGR rate from which the yield of soot serves as a peak will fall a little, and the minimum of the EGR rate [soot] no longer generating almost will also fall a little. Thus, the minimum of the EGR rate [soot] no longer generating almost changes according to the cooling degree and engine load of EGR gas.
[0076] This invention is most applied to a good target by such EGR in the internal combustion engine in which low-temperature combustion is possible. It is because the field shown by drawing 5 appears notably especially in such an internal combustion engine.
[0077] Since the low-temperature combustion by EGR is unrealizable and a particulate accumulates on the top where an exhaust-gas temperature is low at a particulate filter, a particulate can be made to burn by applying the concrete technique shown in examples 1-6 in the particulate deposition field shown by drawing 5 especially in the internal combustion engine which showed such an example 7.
[0078]
[Effect of the Invention] Since the additive containing alkali metals or an alkaline earth metal element is added in playback of a particulate filter according to this invention, the particulate deposited on the particulate filter also in the state of low temperature can be burned.
[0079] And since said additive is added when a particulate accumulates on a particulate filter and it judges that it is the case where a particulate accumulates with a particulate deposition judging means to judge ******, an additive can be used effectively and consumed vainly.
[0080] Furthermore, while having an operational status detection means to detect an internal combustion engine's operational status, it can have an Air Fuel Ratio Control means to control the air-fuel ratio of exhaust gas, and the suitable particulate filter according to operational status can be regenerated by changing the technique of regeneration according to the operational status of the internal combustion engine which detected with the operational status detection means.
[0081] Since an additive is added at an internal combustion engine's combustion anaphase (second half like an expansion line) or a particulate oxidizing quality improves by adding an additive in the fuel for an internal combustion engine, the particulate amount discharged by the internal combustion engine decreases. Since the particulate flammability in a particulate filter also improves to coincidence, the pressure drop buildup of a particulate filter can be controlled.
[0082] If the amount of inert gas of a combustion chamber is increased, the yield of soot will increase gradually and will reach a peak, and this invention can regenerate the particulate filter in such an internal combustion engine on a good target more by applying the amount of inert gas of a combustion chamber to the internal combustion engine which will be in the low-temperature combustion condition [the fuel at the time of the combustion in a combustion chamber and gas ** of the perimeter become lower than the generation temperature of soot, and / soot] no longer generating almost, if it increases further.

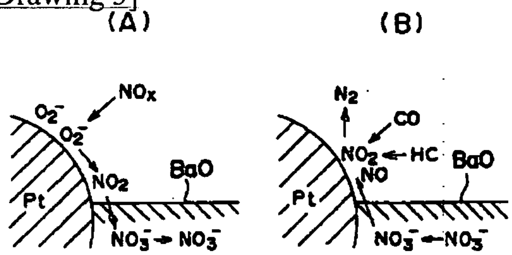
[Translation done.]

DRAWINGS

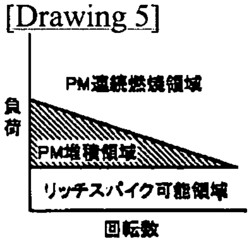
[Drawing 2]



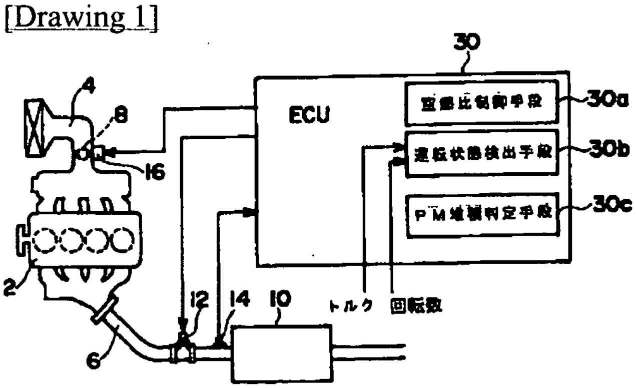
[Drawing 3]



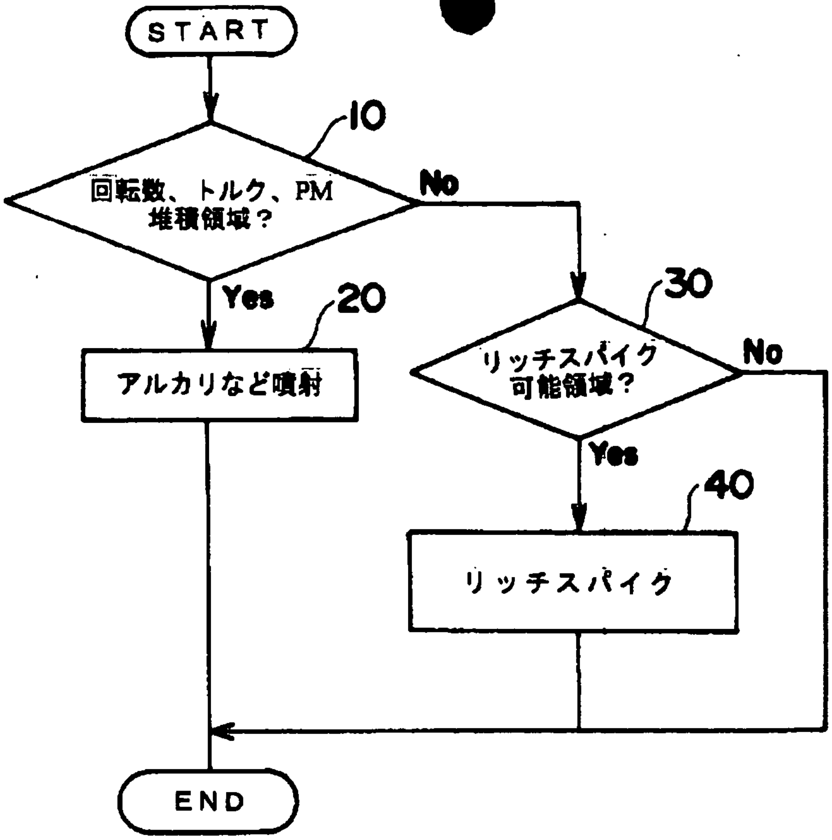
[Drawing 5]



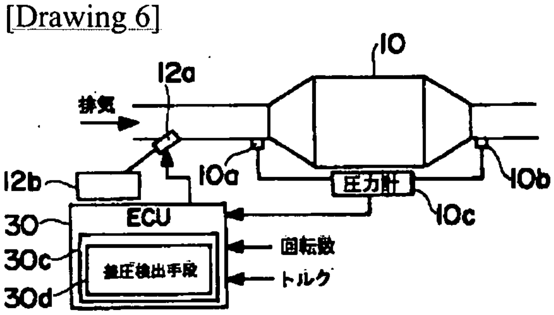
[Drawing 1]



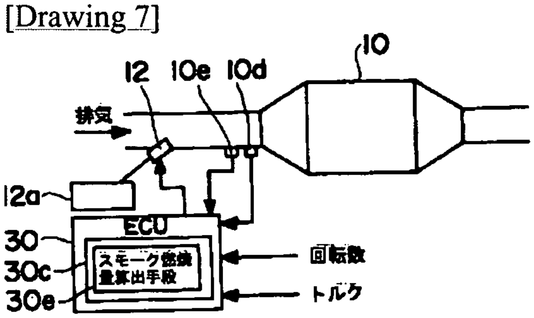
[Drawing 4]



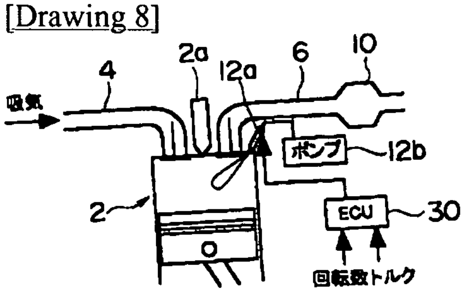
[Drawing 6]



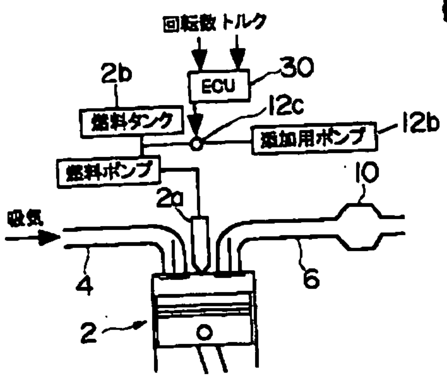
[Drawing 7]



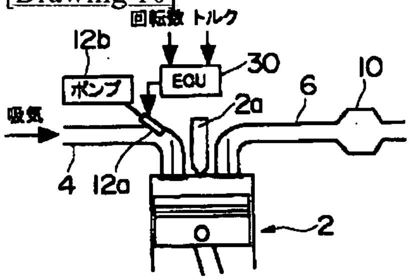
[Drawing 8]



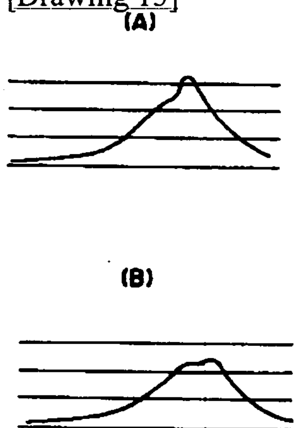
[Drawing 9]



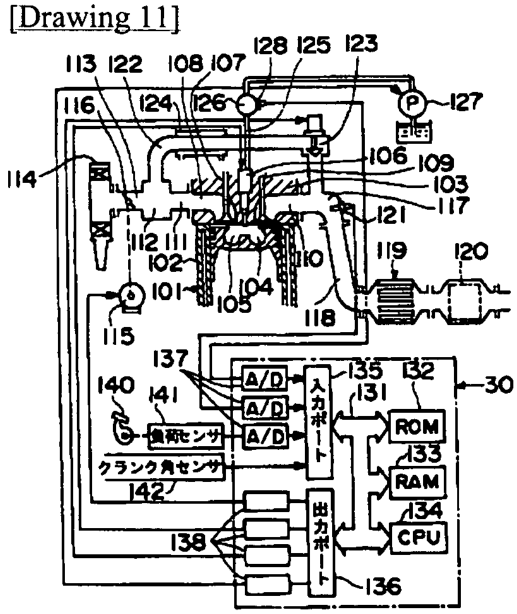
[Drawing 10]



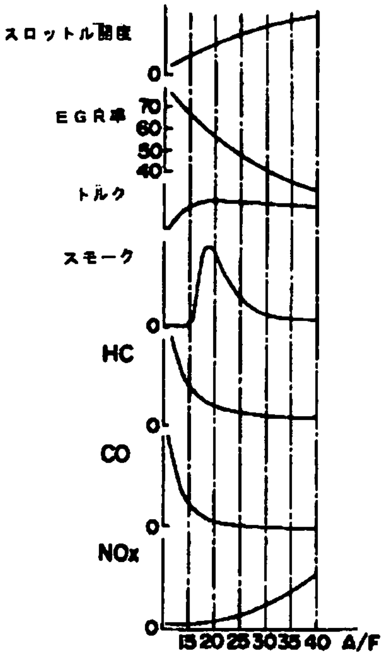
[Drawing 13]



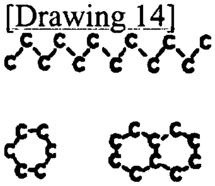
[Drawing 11]



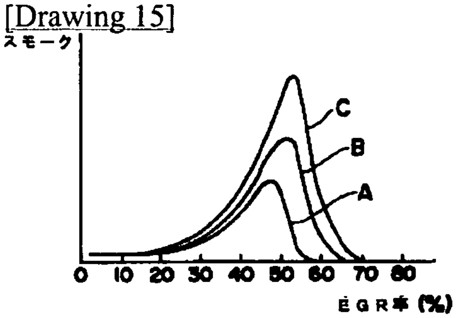
[Drawing 12]



[Drawing 14]



[Drawing 15]



[Translation done.]